TECHNICAL REPORT

Contract Title:	Infrared Algorithm Development for Ocean Observations with EOS/MODIS
Contract:	NAS5-31361
Type of Report:	Quarterly
Time Period:	July-September 1995

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INFRARED ALGORITHM DEVELOPMENT FOR OCEAN OBSERVATIONS WITH EOS/MODIS

Abstract

Efforts continue under this contract to develop algorithms for the computation of sea surface temperature (SST) from MODIS infrared retrievals. This effort includes radiative transfer modeling, comparison of *in situ* and satellite observations, development and evaluation of processing and networking methodologies for algorithm computation and data accession, evaluation of surface validation approaches for IR radiances, and participation in MODIS (project) related activities. Efforts in this contract period have focused on radiative transfer modeling, evaluation of atmospheric correction methodologies, involvement in field studies, production and evaluation of new computer networking strategies, and objective analysis approaches.

MODIS INFRARED ALGORITHM DEVELOPMENT

A. Near Term Objectives

A.1. Continue algorithmic development efforts based on experimental match-up databases and radiative transfer models.

A.2. Continue interaction with the MODIS Instrument Team through meetings and electronic communications.

A.3 Continue evaluation of different approaches for global SST data assimilation and work on statistically based objective analysis approaches.

A.4 Continue evaluation of high-speed network interconnection technologies.

A.5 Continue evaluation of various *in situ* validation instruments for the MODIS IR bands.

A.6 Provide investigator and staff support for the preceding items.

B. Overview of Current Progress

B.1 July-September 1995

Activities during the past three months have continued on the previously initiated tasks with no initiation of new tasks. Dr. Peter Minnett joined our effort as a University of Miami faculty member (Research Professor in Meteorology and Physical Oceanography) effective 1 July, 1995. There have been specific continuing efforts in the areas of (a) radiative transfer modeling, (b) generation of model based retrieval algorithms, (c) continued work on IR calibration/validation as part of the MODIS Ocean Science Team cruise effort, and (e) work on test and evaluation of an experimental wide area network based on ATM technology. Previously initiated activities such as team related activities are ongoing.

B.1.1 Radiative Transfer Modeling

Simulations were done to study methods of splitting the various parameter spaces to improve retrieval equation accuracy. The RAL radiation transfer code is being rewritten to extend its spectral coverage to include the MODIS infrared channels, to improve its performance on Alpha machines, and to permit it to provide profiles of channel radiance through the atmosphere.

B.1.2 Algorithm Development Efforts Based on Experimental Match-up Data bases

The main objective of our recent work is to explore the associations between atmospheric water vapor content and various AVHRR-derived quantities. The paper submitted earlier on this work was returned with ÒstingingÓ reviews. We are examining the reviewersÕ comments and will resubmit it, once appropriate changes have been made.

An extended global marine radiosonde data base is being compiled for use with this model to simulate MODIS brightness temperature measurements.

B.1.3 Wide Area Networking

Efforts to test experimental high speed network between the FORE and DIGITAL ATM switches at the University of Miami were successful in March. SVCs are being established routinely over these connections as appropriate. A network between heterogeneous machines, switches and adaptors (FORE, SGI and DEC) has been implemented and is in use in a production environment. This configuration has carried as much as 40 Gigabytes of traffic per day

B.1.4 *In Situ* Calibration/Validation of MODIS IR Radiances

Work was initiated in January to evaluate several new approaches to infrared radiance measurements cooperatively with Dr. William Smith of the University of Wisconsin. Specifically we participated in a joint study utilizing the NASA ER-2 (MAS and HIS), GOES-8, and two shipboard mounted instruments (AERI and Heimann KT-19). The study occurred in early January, 1995 in the western Gulf of Mexico between frontal passages. Dr. Peter Minnett provided a portable surface meteorology package including long-wave downwelling (Eppley), and a fast response *in situ* temperature probe. Results demonstrate excellent surface radiance

and temperature measurement and concomitant retrieval of SST. A paper reviewing the study was prepared (Smith, *et al*., 1995), submitted to *Bull. Amer. Meteor. Soc.*, and accepted in June 1995. Analyses of these results continues.

We have determined that the AERI will provide measurements of the accuracy and spectral characteristics needed for MODIS-IR algorithm development and validation. Procurement of two modified AERI instruments (Revercomb *et al*., 1993) for use in the marine environment as surface validation instruments was finalized in late July. Resources available in this and the next contract year will be used for this effort. We expect delivery of the first instrument by mid 1996.

Negotiations are underway with the DOE ARM (Atmospheric Radiation Measurements) Program to use a prototype AERI during a research cruise of the NOAA ship Discoverer to the Tropical Western Pacific in 1996. This would provide the opportunity of making atmospheric radiation measurements in extremely moist atmospheres where the SST retrieval problem is most severe, to characterize the effects of the anomalous water-vapor continuum absorption in the MODIS infrared spectral intervals. It would also provide the opportunity to make surface emissivity measurements at the warm extreme of the global SST range.

C. Investigator Support

July	P. Minnett
	J. Brown
	A. Li
	V. Halliwell
August	P. Minnett
	W. Baringer
	J. Brown
	P. Evans
	G. Goni
	A. Li
	D. Li
September	W. Baringer
	J. Brown
	P. Evans
	G. Goni
	A. Li
	D. Li

D. Future Activities

D.1 Current:

D.1.1 Algorithms

a. Continue to develop and test algorithms on global retrievals
b. Evaluation of global data assimilation statistics for SST fields
c. Continue RT modeling using RAL code
d. ATBD updates (as needed)

e. Define and implement an extended ATM based network test bed
f. Evaluate and analyze results of calibration/validation experiment
g. Continued integration of new workstations into algorithm development environment

D.1.2 Investigator support

Continue current efforts

E. Problems

No new problems to report.

F. Publications

Smith, William L., R.O. Knuteson, H.E. Revercomb, W. Feltz, H.B. Howell, W.P. Menzel, N.ÊNalli, O.B. Brown, J. Brown, P. Minnett and W. McKeown. Observations of the Infrared Radiative Properties of the Ocean-Implications for the Measurement of Sea Surface Temperature via Satellite Remote Sensing. *Bull. Amer. Meteor. Soc.*, (accepted).

G. References:

Masuda, K., T. Takashima, Y. Takayama, 1988: Emissivity of Pure and Sea Waters for the Model Sea Surface in the Infrared Window Regions. Remote Sensing of the Environment, 24, 313-329.

Revercomb, H.E., F.A. Best, R.G. Dedecker, T.P. Dirkx, R.A. Herbsleb, R.O. Knuteson, J.F. Short, and W.L. Smith, 1993: Atmospheric Emitted Radiance Interferometer for ARM. Symposium on Global Change Studies. January 17-22, 1993, Preprint.